OBSERVATIONS

ON THE

DEPTH AND TEMPERATURE

OF SOME OF

THE LAKES OF NORTHERN INDIANA.

BY G. M. LEVETTE.

INDIANAPOLIS, INDIANA, December 31, 1875.

PROF. E. T. COX, State Geologist:

Dear Sir: In compliance with your instructions of 1st of August, 1875, Caleb Cooke and myself proceeded to the north part of the State with the necessary apparatus, and seined, dredged and took soundings and temperature of the following named lakes: Lake Manitou, in Fulton county; Pine, Stone and Clear lakes in LaPorte county; Syracuse or Nine-mile, Eagle and Centre lakes in Kosciusko county; Bixell, Latta and Reservoir lakes in Noble county; Twin lakes in Lagrange county, and Crooked and James lakes in Steuben county. On all of which, together with notes on the aquatic molluscan fauna of that region, a detailed report is herewith respectfully submitted.

Yours truly,

G. M. LEVETTE.

REPORT.

Between two and three hundred lakes, varying from a few acres to ten square miles in area, lie within the boundaries of the State, north of Wabash river. Some of them are land-locked, having no visible outlets, or sources of supply, except the rainfall drained into them from the low, narrow, sandy shores and short valleys of the immediately adjoining country. Others are fed by springs and small streams, and have outlets connecting them with the rivers of that well watered region. A few contribute their surplus waters to Lake Michigan through St. Joseph river, others join Maumee through St. Mary's, some flow into Eel river, a number into Tippecanoe and Iriquois, while others help swell the sluggish current of the Kankakee.

These lakes are, without exception, mere basins or depressions in the glacial clay. No stratified rocks have been found in the bottom or on the shores in a single instance, but, on the contrary, the numerous deep bores which have been made in that region, from time to time, prove that from eighty to two hundred feet of glacial drift overlies the stratified rocks throughout the entire lake region of northern Indiana.

Wet, boggy marshes and small lakes which have become dry and arable within the memory of white men; extensive deposits of peat, from five to fifty feet in depth; blind lakes or bodies of water which are covered with a few feet of peaty soil, some of which sustain a growth of forest trees; the annually receding shores of many of the smaller lakes, and the perceptible yearly accumulation of "marl" or fresh water lime in the shallow portions of many of them, all lead to the inference that at no very distant period in the past, the lake area of this region was two or three times its present extent; and further, that if the agencies now at work continue to accumulate material on their shores and beds, not many centuries will elapse before these now

numerous and interesting gems of the landscape will be known only to the students of ancient geography.

Within the past few years a growing interest has clustered about these foot-prints of the glacial flood. The character and origin of the "marl" or chalk and other deposits on the bottoms and ancient beaches of these lakes have become matters of deep interest and searching inquiry; they have been dredged and seined with a hope of finding something "new to science," some reptile, fish or shell heretofore unnamed and undescribed; their oozy beds filtered and the residuum examined with patient care for some new form of microscopic life, and though no directly economic results are apparent to the toiling husbandman as he watches with suspicious distrust the enthusiastic collector, quietly bottling every "creeping thing" revealed by net or dredge; yet each discovery swells the sum of human knowledge, and ere many decades have been added to the past, this class of information will be in demand by the descendants of those who now regard the naturalist with more of scorn than admiration.

The recent successful cultivation of food fishes, in various parts of the world, has prompted inquiries respecting the permanent supply, depth, temperature and other conditions of some of the more important inland bodies of water, with a view of determining to what extent this comparatively new industry is adaptable to them. The wide spread and growing interest on the subjects named, led to the desire for a complete hydrographic survey of the State; but the limited means at the disposal of the State Geologist prevented more than initiatory steps in that direction during the past summer.

Mr. Caleb Cooke, one of the Curators of Peabody Museum, Salem, Mass., a gentleman of extended and varied experience in collecting and preserving natural history specimens for museum use, as well as for scientific study, was engaged to superintend the dredging and seineing. In addition to his wide experience, Mr. Cooke possessed a complete equipment for the prosecution of such work, and

being associated in the same Institution with Prof. F. W. Putnam, an arrangement was effected by which all the ichthyological material collected would be examined by Prof. Putnam, free of cost to the Geological Survey, and full suites of all the species collected, properly labeled, and returned to the State Museum at Indianapolis, and all new species figured and described for publication in this or a subsequent report.

Mr. Cooke's liberal supply of long, deep seines were almost useless here, as the statutes of our State forbid the use of any seine longer than fifteen feet. Due regard for the law prevented the enrichment of our State Museum with many rare and interesting specimens of fish, obtainable only beyond the available limits of a seine of standard legal length, however, with the aid of one assistant, the short nets were used to good advantage in narrow streams, small ponds, and in the shallow water near the shores of the lakes, and several thousands of the smaller fishes were taken, preserved in alcohol and sent to Prof. Putnam for identification.

Mr. Cooke used what is known as the "Naturalist's dredge," consisting of a rectangular iron frame, eighteen inches long by five wide, with the inner edges perforated for the attachment of a stout hempen bag or net with very small meshes; the outer edges of the iron frame were flanged so as to act as a scraper when dragged on the bottom. This dredge is attached to a half-inch rope and lowered into the water from a boat, and by the aid of an assistant, an expert oarsman to propel the boat, the dredge is dragged over the bottom; as the bag soon fills with ooze, mud, sand, gravel, or whatever constitutes the bottom of the lake, it is as often drawn up into the boat, the contents emptied into a sieve for examination and for the selection of specimens for preservation. Samples of the bottom of each lake dredged, were sent to the State Labratory for examination and report.

The writer was specially charged with the duty of ascertaining the depth and temperature of the lakes visited,

observations on the molluscan fauna, and the character of the lake beds and their shores.

The sounding apparatus used consisted of a conical, two-pound iron weight attached to a stout hemp cord, the cord having been carefully measured and knotted with register tabs at intervals of five feet. The thermometer used for taking the temperature of the water was purchased of Mr. James Green, of New York city, and is a self-registering, deep sea thermometer of the Miller-Casella pattern, originally constructed under the direction of the officers of the British Hydrographic Bureau. It consists of a glass tube in the form of the letter **U**, the left limb terminating in a large cylindrical bulb, which is encased in an outer and larger bulb of glass, partly filled with alcohol, which protects the inner bulb from the pressure of the water at great depths. The bend and both limbs contain mercury to about half their length; the left bulb is entirely filled with a mixture of creosote and water, which rests directly on the mercury; the bulb on the right limb is about one-fourth full of the same fluid, the upper three-fourths being empty, or rather containing the vapor of the liquid.

A steel index, about three-tenths of an inch long and small enough to move freely within the tube, rests on either end of the column of mercury; a hair is attached to and coiled about each of these indices, and acts as a spring to hold it at any point to which the rising column of mercury may ascend.

Before using the thermometer the steel indices are drawn down by a magnet until they rest on the ends of the **U** shaped column of mercury; the left end of the tube is graduated to Fahr. degrees from the top downward to mark a decreasing temperature; the right limb is graduated from the bottom upward to mark increasing heat; when the liquid expands in the left bulb, the column of mercury is driven *down* in the left and *up* in the right limb toward the partly filled bulb, carrying the index upward with it to the point of highest temperature then experienced, leaving the index in the left tube at the point from whence the

column of mercury began to recede. When the liquid in the left tube is contracted by loss of heat, the mercury falls in the right limb, leaving the index at the highest point attained by the warmer temperature, and rises in the left limb carrying the index, on that side, to the minimum reached by the falling temperature; thus it is seen that when the indices are drawn down on the mercury in both limbs and the thermometer sunk to the bottom of ocean, lake or well, and, after a few minutes, drawn up, the position of the indices record the limit to which the mercury has been forced by the extreme of heat or cold to which the instrument has been subjected.

To guard against breakage by violent contact with rocks or other objects, the thermometer is enclosed in a cylindrical copper case, perforated at top and bottom to allow the free passage of water over the surface of the instrument.

Miller-Casella thermometers with encased bulb are in use in the United States Coast Survey and the Hydrographic Bureau of Great Britain for all deep sea temperature soundings, and give such universal satisfaction that all old forms of temperature registering instruments have been laid aside. Thermometers of this pattern have been subjected to a pressure of 6,800 pounds to the square inch, at a depth of two and a half miles in the ocean, and not only returned to the surface unimpaired, but gave no reason for doubting the accuracy of the recorded temperature.

On the arrival of Mr. Cooke from the east, we made all necessary provisions for successfully conducting the work, and proceeded to

LAKE MANITOU IN FULTON COUNTY.

This lake lies one mile southeast of Rochester, the county seat, and is about five miles long by one or one and a half miles wide, is irregular in outline, the west shore jutting into the lake giving it somewhat of a crescent shape. Two small islands break the monotony of its surface, one of which is inhabit . Wild rice, *Zizania aquatica*, and

water lilies, *Nymphæa odorata* and *Nuphar advena*, grow in the shallow water near the shores and around the islands. Mill creek, a tributary of Tippecanoe river, enters the lake at the southwest corner and flows out at the north end, where a dam has been constructed, raising the surface level of the lake about nine feet; the water is conducted through a race-way along the bluff, one and a half miles, to the town of Rochester, where it has a fall of twelve feet, and affords sufficient power to run a flouring mill. The shores of Manitou lake are of gravel and glacial clay, with a few inches of well washed sand overlying the clay. In this, as in all other lakes visited in northern Indiana, the bed of the lake is of tenacious, compact clay, varying in color from white, through yellow to dark blue. From these puddled depressions, the water cannot escape, except by evaporation. A generous, annual growth and decay of aquatic plants in the shallow parts of the lake has covered the bottom, in places, with a black, slimy ooze; this annual deposit will eventually raise the bottom above the water level and gradually contract the lake area until only a sluggish rivulet, meandering through a flat, fertile meadow, will mark the site of the present broad and beautiful lake.

At the time white men first visited this section of country it was inhabited by the Pottawattamie Indians, and from that tribe came the name of the lake and the legend which gave rise to it. They believed this body of water to be the home of "*Manitou*," or "Bad Spirit;" that during heavy storms and certain nights in the dark of the moon, he might be seen disturbing and tossing the water, and, in defiance of repeated warnings, a number of dauntless "braves" of the tribe, who ventured to the shore of the lake after nightfall, were never heard of afterward. So firm was their faith in this musty and absurd tradition, they would not venture upon the lake in canoes, or eat fish taken from it.

Bass and pickerel are abundant in lake Manitou, and afford fine sport for those who have the patience to while away their time watching a cork dance idly on the wind-rippled water.

With the assistance of Robert Jewell, Esq., who lives on the west shore of the lake, and keeps for the use of sportsmen a full equipment of boats, spears, jacks, lines, and everything pertaining to fishing and gunning, we proceeded to sound and dredge the lake, and collect specimens for the State Museum.

On the west side of the lake, near the north end, soundings were made and temperature taken as follows:

1st.	Bottom at	20	feet, temperature	62°	F.
2d.	"	30	" "	58°	"
3d.	"	30	" "	58°	"
4th.	"	34	" "	57°	"
5th.	"	28	" "	59°	"
6th.	"	30	" "	58°	"

Returning as near as possible to the 4th station, serial temperatures were taken at intervals of five feet:

Temperature of the air at 9 P. M				56°	F.
"	surface water			65°	"
"	the water at depth of	5	feet	64°	"
"	" "	10	"	64°	"
"	" "	15	"	63°	"
"	" "	20	"	62°	"
"	" "	25	"	60°	"
"	" "	30	"	58°	"
"	" "	34	" bottom	57°	"

From this point we moved to the south of the principal island, passing through shallow water where the prolific growth of water grass and wild rice (*Zizania aquatica*) rendered it difficult to row the boat; reaching deeper water at the south end, near where Mill creek flows into the lake, temperature soundings were taken with the following results:

1st.	Bottom at	20	ft., temperature	58½°	F.
2d.	"	32	"	53°	"
3d.	"	15	"	63°	"
4th.	"	20	"	59°	"
5th.	"	24	"	54°	"
6th.	"	26	"	54°	"
7th.	"	22	"	60°	"
8th.	"	18	"	61°	"
9th.	"	25	"	54°	"
10th.	"	38	"	51°	"
11th.	"	42	"	50°	"

At the last station, No 11, serial temperatures were taken at five foot intervals, as follows:

Temperature of the air at 8 A. M.						66°	F.
"	surface water					65°	"
"	the water at depth of 5 feet					65°	"
"	"	"	10	"		64°	"
"	"	"	15	"		63°	"
"	"	"	20	"		59½°	"
"	"	"	25	"		54°	"
"	"	"	30	"		53°	"
"	"	"	35	"		52°	"
"	"	"	40	"		50½°	"
"	"	"	42	"	bottom.	50°	"

The above tests for temperature were repeated at 10, 20, 30 and 42 feet with confirmatory results. The surface temperature of the shallow water in the mouth of the creek was 66° F. Moving east from this point, the temperature of the bottom was taken, at intervals of about one hundred yards, with the following results:

1st.	Bottom at 13 ft., temperature				64°	F.
2d.	"	20	"		60°	"
3d.	"	17	"		61°	"
4th.	"	17	"		61½°	"
5th.	"	25	"		54½°	"
6th.	"	21	"		60°	"
7th.	"	18	"		62°	"
8th.	"	14	"		63°	"
9th.	"	25	"		54½°	"
10th.	"	28	"		54°	"
11th.	"	28	"		53½°	"
12th.	"	31	"		53°	"
13th.	"	28	"		53½°	"
14th.	"	25	"		54½°	"

Beyond which we run into shallow water with surface temperature at 68°.

Meanwhile Mr. Cooke, with the assistance of Mr. Jewell, Jr., had dredged the lake bottom at several points and bottled samples of the ooze, and collected, in great numbers, several species of the small fishes.

The mollusca observed in this and other lakes will be treated on at the end of this report.

Next in order, of the lakes visited, were those of LaPorte county. Within two miles of the town of LaPorte are seven lakes, all of which are land-locked, having no visible source of supply or drainage. A few of the number, locally called "Muckshaw," are rapidly filling with the roots and decaying tops of an enormous growth of lilies, arrowheads and aquatic grasses; all are being encroached on and through the agency of vegetal growth, will, in time, become swampy marshes—wet, peaty meadows—dry, arable land.

PINE LAKE, LAPORTE COUNTY.

This lake lies about a mile northwest of LaPorte, and is one of a chain of adjacent lakes recently connected by ditches through the natural ridges or embankments which separated them. This body of water is about one mile long, in a north-south direction, and nearly three-quarters of a mile in width. On the east and west sides, the hills are from thirty to forty feet in hight, and composed almost entirely of sand. The bed of this lake, with its substratum of stiff, blue clay, is no exception to the rule, although the superimposed deposit of sand on the shores is of greater depth than at any other lake in this region.

With the aid of one assistant, Mr. Cooke was very successful in securing representative specimens of the fishes, turtles and reptiles of this and neighboring lakes.

Temperature soundings were taken over Pine lake, beginning on the east side, near the garden landing of Mr. Allen, about five hundred feet from the shore, and moving north; depth and temperature, at intervals of about three hundred feet, as follows:

1st.	Bottom at	41	feet, temperature	.....	59° F.
2d.	"	34	" "	.....	61° "
3d.	"	20	" "	.....	63° "
4th.	"	17	" "	.....	64½° "
5th.	"	12	" "	.....	67° "
6th.	"	10	" "	.....	67° "
7th.	"	14	" "	.....	66° "
8th.	"	38	" "	.....	60° "
9th.	"	40	" "	.....	61° "

10th.	"	39	"	"	61° "
11th.	"	30	"	"	62° "
12th.	"	25	"	"	64° "
13th.	"	40	"	"	61° "
14th.	"	12	"	"	66½° "

Returning to 9th station, serial temperature soundings were taken at intervals of five feet, as follows.

Temperature of the air at 9 A. M				62° F.
"	surface water			68° "
"	water at depth of	5	feet	66° "
"	"	10	"	66° "
"	"	15	"	65½ "
"	"	20	"	65° "
"	"	25	"	63° "
"	"	30	"	61° "
"	"	35	"	61° "
"	"	40	"	59° "

Proved the above at 15, 30 and 40 feet. Moved toward southwest corner of the lake, taking depth and temperature as follows:

1st.	Bottom at	50	ft., temperature		56° F.
2d.	"	40	"		61° "
3d.	"	45	"		59° "
4th.	"	42	"		60° "
5th.	"	38	"		61° "
6th.	"	30	"		62° "
7th.	"	52	"		55° "

Took serial temperatures at the last station, as follows:

Temperature of the air at 11 A. M					70° F.
"	"	surface water			68° "
"	"	water at depth of	5	feet	68° "
"	"	"	10	"	67° "
"	"	"	15	"	66° "
"	"	"	20	"	65½° "
"	"	"	25	"	64° "
"	"	"	30	"	62° "
"	"	"	35	"	62° "
"	"	"	40	"	61° "
"	"	"	45	"	58° "
"	"	"	50	"	55° "
"	"	"	52	"	55° "

The above temperature record was proved at 20, 30, 40 and 52 feet.

CLEAR LAKE, LAPORTE COUNTY.

This lake lies north of and adjoining the town, and is one mile across in either direction. It has uniformly low, sandy shores, and sustains a scattered growth of vegetation in the shallow portions. The water owes its turbid, dirty green color to the great quantity of suspended organic matter, confervæ, and perhaps minute animal organisms.

This being the first lake in the group to freeze over on the approach of winter, as stated by the citizens, it also proved upon investigation to be the shallowest. As no congelation can occur on the surface of a body of water until the whole mass has been reduced to the greatest density of fresh water, which contracts uniformly with the falling temperature to 0° C., it follows that the shallower a lake, the less protracted the term of low temperature required to reduce it to the freezing point.

The higher temperature attained in summer by the waters of these land-locked lakes is solely due to direct radiation of the sun's rays, and, as on the approach of winter the obliquity of the rays, their partial obscuration by prevailing clouds and the reduced length of the days, all aid in modifying the daily supply of heat, which is rapidly carried off by cold winds, the surface water is contracted by reduced temperature and displaces the warmer water below, which is thus brought to the surface to impart its heat to the colder air. This motion or convection of the particles is kept up until the whole vertical depth of water is brought to its greatest normal density, and at the moment of freezing it expands sufficient to keep it from sinking, after which convection ceases and the ice is thickened by radiation of heat through the congealed surface, into colder air above.

Since storing ice for summer shipment to southern markets has attracted attention in LaPorte, Clear lake has been observed to be the first of the group to freeze over and afford ice of proper thickness for storing. Just west of the centre of this lake, for a space of two or three acres, the water is only a few inches deep; this may have been

a small hill in the original bed of the lake, but the fishermen insist that it has formed there within a few years; that being true and no currents in the lake, the cause of the accumulation is not clearly understood.

A careful search with the sounding line, for half a day, failed to find any water more than nine and a half feet deep, Forty-two soundings were made, showing from four to nine and a half feet of water, and the temperature ranged from 66° at the surface to 65° at the bottom, in deepest parts.

Notwithstanding the high temperature of this shallow basin of turbid water, it is more resorted to for line fishing from boats than any other lake in the vicinity.

STONE LAKE, LAPORTE COUNTY.

This lake, the last one visited in this vicinity, lies about two miles northwest of town, is about three-quarters of a mile in length, and nearly as wide. It is nearly surrounded by sandy hills from twenty to forty feet high, and is one of the most beautiful sheets of water in the county; the south shore affording sites for four or five suburban residences. Why it should be called "Stone" lake is quite incomprehensible, as no rock of any description is visible in or near it; not a single pebble was seen in the clean, well-washed sand which constitutes the bottom, the shores and the adjacent hills. The water is very free from suspended matter, and so clear that shells can be distinctly seen resting in their oozy bed, under twenty feet of water.

All the eastern half of the lake is shallow, varying in depth from six to ten feet; over a great part of which aquatic grasses are growing luxuriantly, reaching, in many places, to the surface of the water. In the western half of the lake, near the high, bold shore, the water is deeper, reaching forty-two feet at the deepest point found by the sounding line.

Beginning near the eastern margin and moving westward, bottom soundings with temperature, were taken, as follows:

1st.	Bottom	at 8	feet,	temperature.....	69½° F.
2d.	"	8	"	"	69½° "
3d.	"	9	"	"	69° "
4th.	"	18	"	"	68° "
5th.	"	28	"	"	66° "
6th.	"	32	"	"	56° "
7th.	"	36	"	"	56° "
8th.	"	30	"	"	56° "
9th.	"	33	"	"	56° "
10th.	"	41	"	"	55½° "
11th.	"	41½	"	"	55½° "
12th.	"	39	"	"	56° "
13th.	"	33	"	"	56° "
14th.	"	40	"	"	55½° "
15th.	"	42	"	"	55½° "
16th.	"	38	"	"	56° "
17th.	"	36	"	"	55½° "
18th.	"	39½	"	"	55½° "
19th.	"	33	"	"	57½° "

Returning to station No. 15, serial temperatures were taken at intervals of five feet:

Temperature of the air at 2 p. m.....						72° F.
"	"	surface water.....				69½° "
"	"	water at depth of	5	feet.....		69° "
"	"	"	"	10	"	68½° "
"	"	"	"	15	"	68½° "
"	"	"	"	20	"	67½° "
"	"	"	"	25	"	66° "
"	"	"	"	27	"	66° "
"	"	"	"	28	"	66° "
"	"	"	"	29	"	56° "
"	"	"	"	30	"	56° "
"	"	"	"	35	"	55½° "
"	"	"	"	40	"	55½° "
"	"	"	"	42	"	55° "

The above records were repeated with the same results at 20, 25, 27, 28, 29, 30, 40 and 42 feet. Between 28 and 30 feet the thermometer fell 10° and was lowered to about that point several times, but no intermediate temperature was recorded. This fall of 10° in temperature after passing a depth of 28 feet, was observed at other points in the lake, from one to two hundred yards from station 15, where the above serial record was made.

Mr. Cooke and assistant made a trip to Kingsbury in the southern part of LaPorte county, and seined with good success in a small stream tributary to Kankakee river.

While in La Porte, we received special aid and attention from John Sutherland, Dr. T. Higday, H. C. Noe, W. H. Weller, and Messrs. Axtell and Bridges of the Teegarden House.

CENTRE LAKE, KOSCIUSKO COUNTY.

Centre lake lies north of and adjoining the town of Warsaw, and is about one mile long by half a mile across. It is fed by a small tributary of Tippecanoe river, which flows out of the west side of the lake and joins the river after a tortuous course of two or three miles. The low shores and bottom are sandy; lilies and water grasses have secured a firm root-hold in all the shallow parts.

Through the kindness of Judge J. H. Carpenter and Dr. F. Moro, boats were procured, and in the face of a cold, high wind and approaching storm we proceeded to take soundings and temperatures in different parts of the lake. From the west side toward the middle, thence northward, the following observations were recorded:

1st.	Bottom at	36	feet, temperature	....	51½° F.
2d.	"	40	"	....	50½° "
3d.	"	35	"	....	51½° "
4th.	"	10	"	....	66½° "
5th.	"	20	"	....	66° "
6th.	"	30	"	....	55½° "
7th.	"	42	"	....	51° "
8th.	"	40	"	....	51½° "
9th.	"	30	"	....	51½° "
10th.	"	42	"	....	51° "

The high wind caused the boat to drift rapidly to the south, which rendered it quite impossible to fix the stations at regular intervals or equal distances apart; however, the following serial temperatures were taken at intervals of five feet vertically, as nearly as practicable, in the deepest water found:

Temperature of air at 4 P. M.				56° F.
"	surface water			69° "
"	water at depth of	5	feet	68° "
"	"	10	"	67° "
"	"	15	"	66° "
"	"	20	"	65½° "
"	"	25	"	61° "
"	"	30	"	55½° "
"	"	35	"	51½° "
"	"	40	"	51½° "
"	"	42	"	51° "

The second trial at 25 feet gave 58°, but the wind had, at that time, increased to such a gale that further work was impracticable.

EAGLE LAKE, KOSCUISKO COUNTY.

Is one and a quarter miles south of Warsaw, is two miles long from north to south and three-quarters of a mile wide. The vast accumulation of peat on the sloping shores indicate a water-level, in past time, several feet higher than at present. A heavy growth of marsh grass, on the eastern margin and at the south end, is gradually invading the water area by a slow accumulation of peaty matter, and although this was the deepest body of water visited, the time can not be very remote when its bed will be raised to the level of the adjoining arable meadows.

A small stream, having its source in the higher lands to the south, flows through this lake, and in its course, through Centre lake and thence to Tippecanoe river.

About the year 1860, some citizens of Warsaw introduced White fish (*Coregonus albus*) into Eagle lake from Lake Michigan; they are occasionally caught here, but have never become abundant. Lake herrings (*Argyrosomus sisco*, Jordan), closely allied to white fish, abound in all the lakes tributary to Tippecanoe river. They leave the deep water of the lakes in November, and pass into the small streams to spawn, at which time great numbers can be taken with a short seine or dip-net. They bear salting, and are much esteemed by the citizens in the vicinity of streams where they occur.

After the storm of the preceding day had passed, though still too cold and windy for pleasant or reliable work, we visited Eagle lake, equipped for taking soundings and recording the temperature of the water. Starting from the the north end of the lake and moving southward, the following records were made:

1st.	Bottom at	35	feet, temperature	50°	F.
2d.	"	37	"	50°	"
3d.	"	50	"	49½°	"
4th.	"	74	"	47°	"
5th.	"	78	"	46½°	"

Serial temperature soundings were taken at station 5, at intervals of ten feet, with the following results:

Temperature of air at 3 P. M				52°	F.
"	surface water			66½°	"
"	water at depth of	10	feet	65½°	"
"	" "	20	"	63½°	"
"	" "	25	"	56°	"
"	" "	30	"	53°	"
"	" "	40	"	49°	"
"	" "	50	"	48°	"
"	" "	60	"	47½°	"
"	" "	70	"	47°	"
"	" "	78	"	46½°	"

Repeated and confirmed at 20, 30, 50 and 78 feet.

Moving from centre towards west side of lake, the following records were made:

6th.	Bottom at	62	feet, temperature	47°	F.
7th.	"	58	"	48°	"
8th.	"	76	"	47°	"
9th.	"	70	"	47°	"
10th.	"	50	"	48½°	"

A more thorough and detailed survey of this deep water-basin was desirable, but the wind had increased so as to render the boat unmanageable for accurate soundings, and being unprovided for so great a fall in temperature, we were reluctantly compelled to return to Warsaw.

Going north from Warsaw to Syracuse, in Kociusko county, a number of lakes were passed, but want of time and

local conveniences prevented any attempt to dredge or sound them.

SYRACUSE OR NINE-MILE LAKE, KOSCIUSKO COUNTY.

This lake, as it name implies, is nine miles long, from north to south, and from one to one and a half miles wide; it lies south of and adjoining the town of Syracuse, a station on the Baltimore, Pittsburg and Chicago railroad. This is a wide expanse of shallow water, over nearly the whole of which, wild rice and water grasses, annually make a luxuriant growth; at many places, near the shores, in the shallower water, the growth of rice is so heavy that propelling a boat with oars is quite impossible. This dense growth of vegetation in the lake and adjoining marshes affords fine cover and feeding grounds for water fowl, and for duck, snipe and rail shooting the place is widely and favorably known among sportsmen. White, black and striped bass (*Roccus*) and pike (*Esox americanus*) grow to good size here and are taken in abundance.

The lake is bordered on the east by an extensive marsh, which is, in turn, skirted by bluffs of glacial clay from thirty to fifty feet in hight. The shores and bottom are of sand, which is reported to be from one to five feet deep, with a sub-stratum of blue clay. Elkhart river conducts the surplus water into St. Joseph river on its way to Lake Michigan.

Soundings were taken in the north end of this lake with the following results:

1st.	Bottom at	22	feet,	temperature.....	59° F.
2d.	"	25	"	"	59° "
3d.	"	28	"	"	58½° "
4th.	"	30	"	"	58° "
5th.	"	28	"	"	58° "
6th.	"	35	"	"	57° "
7th.	"	36	"	"	57° "

Serial temperature soundings were taken at the last station with the following results:

Temperature of air at 9 A. M.					58°	F.
"	surface water				64°	"
"	water at depth of 5 feet				61½°	"
"	"	"	10	"	61°	"
"	"	"	15	"	60°	"
"	"	"	20	"	59°	"
"	"	"	25	"	58½°	"
"	"	"	30	"	58°	"
"	"	"	35	"	57°	"
"	"	"	36	"	57°	"

The above record was proven at 20, 30 and 36 feet.

While at Syracuse we were placed under obligations, for courtesy and attention, to D. C. Kelley, M. D. Mr. Wynant, druggist, Evan Miles, Esq., and the editor of the paper, to whom an apology is due for failing to remember his name.

RESERVOIR LAKE, ROME CITY, NOBLE COUNTY.

This is an artificial lake formed by a dam thrown across a small tributary of Elkhart river, for hydraulic purposes. This lake is near three miles long by half a mile in width; several islands, supporting groves of native timber, are enclosed; these charmingly cool, shady retreats, are very popular with pic-nic parties from neighboring towns. The Grand Rapids and Indiana railroad, extending from Fort Wayne, Ind., into western Michigan, passes through Rome City. Reservoir Lake and the Lake Side House are within a stone throw of the depot. I. N. Berry, proprietor of the hotel, to whom we are under obligations for special attentions, keeps a full equipment of boats and fishing tackle for the use of pleasure parties and sportsmen.

There being fifteen lakes and many thousands of acres of meadows and marshes within a few miles of this place, it is widely known and popular with Waltonian experts, and lovers of snipe and duck shooting.

The lake is not deep, as will be seen by the following record of soundings :

1st.	Bottom at	18 feet,	temperature.....	57½° F.
2d.	"	16	"	57° "
3d.	"	17	"	57½° "
4th.	"	21	"	57° "
5th.	"	25	"	57° "
6th.	"	22	"	57° "
7th.	"	23	"	57° "
8th.	"	22	"	57° "
9th.	"	17	"	57½° "

Returning to station 5, serial temperature soundings were taken at intervals of five feet:

Temperature of air at 11 A. M.....					.....	70° F.
"	surface water.....				.....	61° "
"	water at depth of		5	feet.....	.....	60° "
"	"	"	10	"	.....	59° "
"	"	"	15	"	.....	58° "
"	"	"	20	"	.....	57½° "
"	"	"	25	"	.....	57° "

About one mile southeast of Reservoir lake, and farther up the same stream, lies

LATTA LAKE, NOBLE COUNTY.

This is a small body of water of about sixty or eighty acres extent, nearly surrounded by hills rising from thirty to fifty feet above the water level. The wide margin of peat bog which skirts the lake indicates an expanse, in past time, of many times its present area.

The ancient lake shore, outside and above the peat bog, is made up of sand and fine, white gravel, beneath which blue clay is exposed in the roadways and ditches.

Moving from the east end of this lake to about the middle, soundings were made as follows:

1st.	Bottom at	16 feet,	temperature.....	58½° F.
2d.	"	18	"	58½° "
3d.	"	26	"	57° "
4th.	"	28	"	56½° "
5th.	"	28	"	56½° "
6th.	"	33	"	56° "
7th.	"	30	"	56½° "
8th.	"	34	"	56° "
9th.	"	29	"	56½° "

Returning to station 8, the temperature was taken at intervals of five feet, from the surface to the bottom:

Temperature of air at 3 P. M.					68°	F.
"	surface water				60°	"
"	water at depth of 5 feet				60°	"
"	"	"	10	"	59°	"
"	"	"	15	"	58½°	"
"	"	"	20	"	58°	"
"	"	"	25	"	57°	"
"	"	"	30	"	56½°	"
"	"	"	34	"	56°	"

TWIN LAKES, LAGRANGE COUNTY.

These are two small lakes separated by a bar of sand, marl and gravel, about five hundred feet across. The presence of marl and an infinite number of fragments of of mussel shells in this sandy bar, point to a time not very remote when these Twins were one continuous sheet of water. The low shores on the north and east are sandy, while on the south margin of the larger lake, vegetal growth has built up a respectable peat bog. The latter, in which soundings were taken, is a mile and a half in an east-west direction, and from a quarter to a half mile in width. A heavy growth of rushes (*Juncus?*) and other water-loving vegetation has set in on both sides; over a great portion the water is from two to five feet in depth, but at the west end a long strip of deeper water was found, the soundings and temperature of which is here recorded.

Temperature of air at 3 P. M.					64°	F.
"	surface water				60°	"
"	water at depth of 5 feet				58½°	"
"	"	"	10	"	57°	"
"	"	"	15	"	57°	"
"	"	"	20	"	56°	"

Several subsequent observations in other parts of the lake confirmed the above record.

CROOKED LAKE, STEUBEN COUNTY.

This lake is located about five miles northwest of Angola, the county seat, is between two and three miles long, by

about one mile in width, and has low sloping shores, which rise to twenty or thirty feet above the present water level; the north and east shores are sandy, and the shallow marginal water is quite free from vegetation, while all along the south side, aquatic plants have secured strong root-hold, and are seen rising a foot or more above the surface of the lake.

In this lake the deposition of lime (locally called "marl,") from the water, by the action of light and vegetal growth, may be studied to advantage. The water is of crystal clearness, and objects on the bottom, under ten or fifteen feet of water, may be distinctly seen; mussels (*Uniondæ*) are very abundant, and the posterior part of the shells, through which the breathing tubes project up into the water, are, in this lake, almost universally built up with a soft, pasty deposit of lime, varying in thickness from a half inch to an inch and a half, giving them the appearance of being much longer than they really are. This coating of lime excludes the light so completely that the epidermis beneath is a pale salmon hue, and without the rays and color markings peculiar to the species in running streams. The broken surfaces of stones, bits of wood, which, from partial decay, have sunk to the bottom, and the dead stalks of grass and weeds, are all coated with a film of lime. This incrustation appears to accumulate more rapidly in shallow water, where the sun's rays heat it more quickly and to a higher temperature, than in deeper portions of the lake.

A bottle of water was taken from this lake and sent to the laboratory at Indianapolis, an analysis of which is given on page 40 of this Report.

To a leaky boat, high wind and an inexperienced oarsman, may be charged the failure to reach the deepest point in Crooked lake, and acquire the information desired. The following record shows what was done; beginning on the east side and moving in a west course, soundings were taken as follows:

1st.	Bottom at	25 feet,	temperature	55°	F.
2d.	"	28 "	"	54°	"
3d.	"	30 "	"	54°	"
4th.	"	28 "	"	54½°	"
5th.	"	30 "	"	54°	"

At the latter station serial temperature soundings were taken as follows.

Temperature of	air at 2 P. M.			64°	F.
"	surface water			59°	"
"	water at depth of	5 feet		58°	"
"	" "	10 "		57°	"
"	" "	15 "		56°	"
"	" "	20 "		55°	"
"	" "	25 "		54½°	"
"	" "	30 "		54°	"

JAMES LAKE, STEUBEN COUNTY.

This lake lies one mile northeast of Crooked lake, is five miles long from north to south and from one-half to three-fourths of a mile wide. The east side of the lake is bordered by high hills, while the west side is approached over gently sloping meadows, cultivated to the waters edge; one or two small islands are enclosed by its waters. A heavy deposit of lime or "marl" on the west margin was, in the early settlement of that region, worked for lime for making mortar; the marl pits are still visible.

Lake James is quite celebrated for its fine fish, which are taken with hook or spear as the caprice of the sportsmen may determine. Lake herrings (*Argyrosomus sisco*, Jordan) occur in great numbers in this lake, and are seined in quantities from the small tributaries, where they go, in November, to spawn. Aquatic plants are encroaching on the water in almost all directions, giving the margins a marshy appearance.

We went on the lake from the west side, rowed to about the middle, and moving from thence south; soundings were taken as follows:

1st.	Bottom	at 40	feet,	temperature.....	55° F.
2d.	"	69	"	.....	50° "
3d.	"	55	"	.....	51° "
4th.	"	60	"	.....	50½° "
5th.	"	50	"	.....	53° "
6th.	"	64	"	.....	50° "
7th.	"	70	"	.....	49½° "

As station 7, serial temperature soundings were made, as follows:

Temperature of air at 4½ P. M.....					62° F.
"	surface water.				60° "
"	water at degth of 5 feet.....				58° "
"	"	"	10	"	57° "
"	"	"	20	"	56½° "
"	"	"	30	"	56° "
"	"	"	40	"	55° "
"	"	"	50	"	53½° "
"	"	"	55	"	52° "
"	"	"	60	"	50½° "
"	"	"	65	"	50° "
"	"	"	70	"	49½° "

Other trials confirming the above were made at 30, 50 and 70 feet.

Considerable time was spent rowing over the lake sounding for deeper water, but without success; at all subsequent soundings, the temperature, at corresponding depths, uniformly agreed with the above.

I am under great obligations to Messrs. Frank McCartney and Alvah Carpenter, of Angola, for aid and attention while in Steuben county.

BIXELL'S LAKE, NOBLE COUNTY.

This lake is situated east of and adjoining the town of Kendallville, and is about three-fourths of a mile long in a north-south direction, by a little less than half a mile in width. It has been much reduced in area by heavy accumulations of peat at the north and south ends. The west shore is sandy, and where the bottom was dredged up, it was composed of sand mixed with black muck or decomposed vegetal matter.

Beginning at the north end and moving south, soundings were recorded as follows:

1st.	Bottom at	25 feet,	temperature	55°	F.
2d.	"	32	"	54½°	"
3d.	"	28	"	55°	"
4th.	"	35	"	54°	"
5th.	"	41	"	53°	"

The temperature of the water was taken at serial depths near station 5, in 41 feet of water:

Temperature of air at 10 A. M				66°	F.
"	surface water			61°	"
"	water at 5 feet depth			59°	"
"	"	10	"	57½°	"
"	"	15	"	56½°	"
"	"	20	"	56°	"
"	"	25	"	55°	"
"	"	30	"	54½°	"
"	"	35	"	54°	"
"	"	40	"	53°	"
"	"	41	"	53°	"

Acknowledgements are due to James Colgrove, G. C. Glatte, Hon. Wm. Bunyan and C. O. Myers, editor of the Kendallville Standard, for favors and assistance while in Noble county.

MARL.

In a bluff about one mile north of Rome City, Noble county, on the land of Mr. Geisendorff of Indianapolis, a ditch has exposed a deposit of marl or fresh water chalk several feet in thickness. Other heavy deposits were reported in the same neighborhood. In the absence of a better article, this might be burnt and used for making mortar, but its chief value lies in its fertilizing properties when spread over the clay lands of the vicinity, after having been burnt and slaked.

An analysis of this marl is given on page 41 of this report. Containing over one-half per cent. of phosphoric acid, its value as a fertilizer, on land devoted to the growth of cereals, at once becomes apparent.

Many of the lakes throughout this region are bordered with similar deposits, varying from a few inches to twenty feet in thickness. The western shore of Lake James, in Steuben county, is a notable locality, and on the land of G. W. Slocum, in the same county, is a small lake, the shores which are almost wholly made up of this material, of a remarkable degree of purity, an analysis of which appears on page 41.

FOOD FISHES.

The lakes referred to in the preceding pages and many others within the State are, to a greater or less extent, stocked with several species of food fishes, among which the following are prominent:

Striped Bass, (*Roccus chrysops*).
Black Bass, (*Micropterus nigricans*).
Goggle Eye, (*Ambloplites rupestris*).
Croppie, (*Pomoxys annularis*).
Pickerel, (*Esox lucius*).
White Fish, (*Coregonus albus*).
Lake Herring, (*Argyrosomus sisco*).

The above are eagerly sought after by the citizens in the vicinity of the respective lakes, and great numbers are taken with hooks and spears, and in many instances, in violation of law, in fish baskets, traps and long seines. A few of the lakes, lying convenient to railway travel, are annually visited by hundreds of anglers from the cities of this and adjoining States. True Waltonian sportsmen seek for game fish only, and scorn those that will not take *live* bait; and to these there could be no objection if they would forbear during the spawning or "nesting" season.

Citizens living near the fishing grounds might do much toward increasing the quantity of the fish by rigidly enforcing the existing State Fish Law, prevent seining at any time and the capture or destruction of fish, by any means, during the time of spawning.

Dog Fish (*Amia calva,*) and Gar Pikes (*Lepidosteus osseus,*) occur in considerable numbers in some of the

TABULATED RECAPITULATION OF SERIAL TEMPERATURES.

DEPTH.	Eagle Lake.	James Lake.	Pine Lake.	Stone Lake.	Manitau Lake.	Bixell's Lake.	Centre Lake.	Syracuse Lake.	Latta Lake,	Crooked Lake.	Reservoir Lake.	Twin Lake.	Clear Lake.
Air	52	62	70	72	66	66	56	58	68	64	70	64	68
Surface water	66½	60	68	69½	65	61	69	64	60	59	61	60	66
5 feet		58	68	69	65	59	68	61½	60	58	60	58½	65½
10 "	65½	57	67	68½	64	57½	67	61	59	57	59	57	65
15 "			66	68½	63	56½	66	60	58½	56	58	57	
20 "	63½	56½	65½	67½	59½	56	65½	59	58	55	57½	56	
25 "	56		64	66	54	55	61	58½	57	54½	57		
28 "	54			66						54			
30 "	53	56	62	56	53	54½	55	58	56½	54			
34 "									56				
35 "	50½		62	55½	52	54	51½	57					
36 "								57					
40 "	49	55	61	55½	50½	53	51½						
41 "						53							
42 "					50		51						
45 "			58	55½									
50 "	48	53½	55										
52 "			55										
55 "		52											
60 "	47½	50½											
62 "	47												
65 "		50											
70 "	47	49½											
74 "	47												
78 "	46½												

waters of this State, and are terribly destructive to the young of all choice food fishes. It has been estimated by a shrewd observer on the shore of Lake Michigan, that the yearling White Fishes, annually destroyed by one medium size Dog Fish, would, as "three-year-olds," exceed a ton in weight. This added to the great increase in numbers, if allowed to spawn, gives a limited idea of the frightful cost of sustaining these piscivorous gormands, which, as well as the equally destructive Gar Pike, is always coarse, rank and unpalatable.

The question may be asked, why cannot the fish law be so modified as to allow, if not encourage, the destruction, at all times, of the two species above named?

Fully three-fourths of the lakes within the State are eminently fitted for the introduction of such species of the Salmonidæ as do not, from necessity, spend a portion of each year in salt water.

The National Government, through its efficient Fish Commissioner, Prof. Spencer F. Baird, is doing a grand work by stocking the larger streams and lakes of the United States with the better class of food fishes, and if seconded by State legislation for the protection of introduced species at proper seasons, the streams, once so full of native fishes, will soon again swarm with an abundance of wholesome, nutritious and palatable food. As the field of operations of the U. S. Fish Commissioner is as wide as the continent, and the means at his disposal quite limited, it would seem perfectly proper for our State or County authorities to solicit the co-operation of the Commissioner, and render local aid in the introduction, into some of the lakes in the State, of such non-migratory species as he may have for distribution.

MOLLUSCA.

The lakes of northern Indiana contribute to four distinct systems of drainage: through St. Joseph river into Lake Michigan, through Maumee river into Lake Erie, through

Kankakee river, across the State of Illinois, into Mississippi river, and through Wabash into Ohio river. Notwithstanding this wide scattering of the waters of these lakes, their molluscan fauna have many striking characteristics in common.

Nearly all the species observed are common to all the lakes and streams, while a few are more restricted in their range. One peculiar feature of all the lake shells is their extreme frailty—uniform want of weight and substance. The necessities of molluscan life in the quiet beds of currentless lakes may not demand the same weight and strength of external shell as required by their more exposed congeners in the gravelly beds of swift running streams. That there is no paucity of shell-building material present in the water is shown by the constant, generous deposition of nearly pure carbonate of lime on all the shells, sticks and decayed plant stocks, and in the heavy "marl" deposits on the borders of many of the lakes, and further, by an analysis of the water of James Lake, p. 40 of this Report, which shows seven grains of carbonate of lime in a gallon. *Unio luteolus*, Lam., a shell of very extended range, when taken in any of these lakes is found to be comparatively frail; having only about half the weight of shell of specimens of the same size taken from Wabash river, or its swift, gravel-bottomed tributaries.

This comparative frailty of shell in the Unios of the lakes was not observed in the Anodontas; that sub-genus is, as a rule, more prolific and grows to larger size in lakes and ponds than in flowing streams, but the amount of shell accumulated, by specimens, of a given size, from lakes and streams respectively, do not exhibit any marked difference.

Very few pustulate or rugose shells were observed in this region. In the gravelly parts of the northern tributaries of Wabash river *Unio verrucosus*, Bar. and *Margaritana rugosa*, Bar. are occasionally met with. In St Joseph river, St, Joseph county, *Unio pustulosus*, Lea, occurs sparingly, the specimens bearing a strong resemblance to *U. schoolcrafti*, Lea. In 1873, *U. kirtlandianus*, Lea, was taken

by the writer, from a small stream in DeKalb county, and dead shells of that species were afterward seen along a tributary of Tippecanoe river. *Unio occidens*, Lea, *U. ligamentinus*, Lam., *U. luteolus*, Lam., *U. pressus*, Lea, and *Anodonta edentula*, Say. are common to all the running streams of the region under consideration. *U. occidens*, Lea, *U. luteolus*, Lam., *Anodonta edentula*, Say, *A. plana*, Lea, *A. fragilis*, Lam., *A. imbecilis*, Say, are found in all the lakes. *Unio nasutus*, Say, was observed only in Lake Manitou, though there is no apparent good reason why they may not be found in all the lakes connected with that line of drainage.

The following is a list of the *Unionidæ* taken, by the writer, at different times, north of Wabash river:

Unio circulus, Lea, Eel river.
" *clavus*, Lam., Eel, St. Joe and Tippecanoe rivers.
" *fabalis*, Lea, Eel river.
" *glans*, Lea, Eel river.
" *kirtlandianus*, Lea, tributaries of Maumee and Tippecanoe rivers.
" *ligamentinus*, Lam., all the streams.
" *luteolus*, Lam., all the lakes and streams.
" *multiradiatus*, Lea, Eel and Tippecanoe rivers.
" *nasutus*, Say, Lake Manitou.
" *occidens*, Lea, all the lakes and streams.
" *pressus*, Lea, all the streams.
" *pustulosus*, Lea, St. Joe river.
" *rangianus*, Lea, Eel river.
" *spatulatus*, Lea, St. Joe river.
" *verrucosus*, Bar., tributaries of Wabash river.
Margaritana rugosa, Bar., Eel river.
Anodonta edentula, Say, all the lakes and streams.
" *fragilis*, Lam. all the lakes.
" *imbecilis*, Say, all the lakes.
" *plana*, Lea, all the lakes.

To John W. Byrkit, Esq., of this city, is due the credit of preparing the following list of fresh water Univalve

shells known to inhabit the lakes and streams in Indiana, north of Wabash river:

Limnæ stagnalis, Linn.
L. s. var. *appressa*, Say.
L. s. var. *jugularis*, Say.
Limnophysa reflexa, Say.
L. r. var. *exilis*, Lea.
L. r. var. *elodes*, Say.
L. desidiosa, Say.
L. catascopium, Say.
L. caperata, Say.
Physa gyrina, Say.
P. heterostropha, Say.
Bulimus hypnorum, Linn.
Helisoma trivolvis, Say.
H. t. var. *regularis*, Lea.
H. bicarinatus, Say.
Menetus exacutus, Say.
Gyraulus parvus, Say.
Valvata tricarinata, Say.
Vivipara contectoides, Say.

TESTUDINATA.

The following is a list of turtles known to inhabit this region:

Aspidonectes spinifer, Lesueur, soft shell turtle, Kankakee river and, possibly, all the lakes.
Chelydra serpentina, Linn., snapping turtle, all the lakes and larger streams.
Aromochelys odoratus, Lat., musk turtle, nearly all the lakes,
Aromochelys, sp.? Clear Lake, LaPorte.
Pseudemys hieroglyphica, Hol., hard shell, Kankakee river.
Malacoclemmys geographicus. Les., green head, Eel river, St. Joe. river.
Chrysemys picta, Herm., var. *marginata*, Agass, painted turtle, all the streams and lakes.
Nanemys guttatus, Schn. speckled back, ditches around Kendallville, and, doubtless, over the whole region.
Emys meleagris. Shaw, land turtle, sparingly in the northern parts of LaGrange and Steuben counties.

MOUNDS AND ANTIQUITIES.

Through the kindness of James Colgrove, of Kendallville, we were shown some mounds near Little Turkey

lake, in the southwest corner of Steuben county. One on the roadside, about ten feet in diameter, and ten feet high, had been opened; it was of coarse gravel and sand, the same as the surface soil in the adjoining field.

A few rods southeast of this, in the woods, we visited a well defined mound, twenty-five feet in diameter, and four and a half feet high; the centre had been dug out, a deeper excavation was made, reaching down to the level of the surrounding soil, without finding any bones, or other evidences of burial. About a quarter of a mile further south, on land of Frank Glascow, near the margin of a marsh, (ancient lake,) another mound was discovered, having about the same dimensions as the one last mentioned. An excavation was made in the top, and at the depth of three feet, ashes, charcoal, and fragments of human bones were found; about one foot below these another layer of ashes and charcoal was encountered, among which were the much decayed bones of an adult human being; associated with the pelvis bones were fragments of a skull, jaw bones, and well preserved, but much worn teeth, indicating burial in a sitting posture. One stone implement was taken out—a chisel-shaped slab of mottled slate, four and a half inches long by two inches wide, and one quarter of an inch thick, with one corner broken off.

Subsequently Mr. G. C. Glatte, of Kendallville, took us eight miles north, to the farm of E. Shaddock, on west side of Cree lake, where, a group of seven mounds are located, on a tract of land of about twenty acres. The largest and central mound of the group is sixty feet in an east–west direction, and twenty-five feet north-south. Six others, of smaller dimensions, are located about the central mound, at unequal distances from it and each other, arranged without the least reference to any apparent plan or system.

With the assistance of Chas. Weingart, a neighboring farmer, two excavations were made in the largest mound, about twenty feet from either end. In each excavation, on the surface level upon which the mound was built, a human skeleton was found; in both instances, they were lying

with heads to the north on the right side, facing west. The bones had become so softened by long exposure in the ground that it was impossible to raise any single bone entire. In the east opening, Caleb Cooke, with patient care, removed the earth from about the cranium and took it up in pieces, which, after drying, were glued together, making the specimen almost entire. In the cranium, just referred to, the temporal bone, left side, had been crushed through, leaving an irregular hole about one and a half inches in diameter; within the skull, with the sand which filled the cavity, two small balls or cakes of clay were found of about the same diameter as the hole. Mr. Cooke suggested that the person might have met with a violent death and the clay was used as a dressing for the wound or to hide the ugly scar at the time of burial.

From the opening in the west end, the cranium was removed entire without disturbing the enclosed, compact, wet sand, it was carefully packed in sawdust and brought to the State Museum in good condition*. Evidences of fire—ashes, small bits of charcoal and calcined earth—were found in this mound, but no implements or vessels. Want of time prevented the examination of other mounds in this group.

Returning to Kendallville by another route, several mounds were seen on the bluff which skirts the marsh around Turkey lake, near Wolcottville, in Lagrange county.

Four miles southeast of Kendallville, on land of Mrs. Ann Field, there is an oval mound about one hundred and twenty feet the long way, eighty feet across and twenty-five feet high. It is in the woods and covered with trees of

*For the benefit of inexperienced persons who may undertake exhuming prehistoric skeletons, it may be stated that many interesting and valuable crania are wholly destroyed by attempting to take them up in pieces. The partially decomposed, wet bone is soft and spongy and readily disintegrates by careless handling; while, if taken up entire, its earthy contents act as a core or support, and if, before drying, it is packed in sawdust or earth (to exclude the air) and allowed to remain until the whole mass is dry, the bone will harden sufficiently to bear handling, after which the contents may be removed and the specimen preserved for study and comparison.

same size as those on adjacent land. About 40 rods distant there are several smaller mounds; some of which have been opened, yielding stone axes, arrow points, and fragments of charcoal.

Extensive systems of earth-works, often occupying commanding positions on hills, bluffs or bends in the streams; mounds of various sizes and forms, ascribed by writers, according to their fancy, to special uses, as: worship, sacrifice, burial, observation, signal or habitation; large areas enclosed by angular or circular embankments, often surrounded by or enclosing a number of smaller works, and nearly always located near streams or lakes, and when in a forest, sustaining trees as great in size and age as those adjacent; and nowhere, by ground plan or relation to each other, indicating any existing knowledge of the points of the compass. These mute, unlettered monuments of a vanished race, in a thousand modified forms, lie scattered throughout the Mississippi valley.

A few, perhaps a respectable number, of the archæologists of this day, have sought to show, from the identity of the stone implements taken from the mounds, with those made and used by existing tribes, that the Indians, found on this continent at the time of its discovery by Columbus, were lineal descendents of the Mound Builders. This conjecture, as probable and rational as any, is not sustained by the traditions, which are known to have been carefully (if not always truthfully) handed down from generation to generation, and which always omitted any knowledge of the great earth-works, or their builders.

Whether the Mound Builders perished as a race, and the Indians were subsequently introduced from other sources, or whether the Indians are directly descended from a mound building ancestry, are queries which, in the light of existing evidence, baffle investigators.

The age of trees found growing upon some of the earth-works, (in a few instances recording nearly nine hundred years,) only obscure the solution, by suggesting that they may have been planted by the Builders, or, that the works

may have been barren of arboreal growth, until after the race, which erected them, had ceased to exist. Dead centuries of unrecorded experience interpose a vast chasm between that mysterious people and ourselves, and dim, disconnected and unreliable are the few intelligible signs which span it

Science, flushed with its wonderful progress in the past few decades, stands mute and powerless over the abyss of time which separates us from the origin, life-history and destiny of that buried race. Archæologists have mapped the banks, trenches and tumuli, collected stone implements, unchanged from the hand of the artisan, filled museums with relics of their rude handiwork, and printed libraries of theories and suggestions; eminent men have devoted valuable lives to the study of their effects, yet over their life-history, habits, manners, customs, dress, food, language, origin and fate, reigns an infinitude of uncertainty.